

Non-Binding Arbitration initiated 10/21/08
pursuant to
Decree of May 19, 2003, 538 U.S. 720
Kansas v. Nebraska & Colorado
No. 126, Orig., U.S. Supreme Court

Engineering Analysis of Losses to Kansas Water Users
Resulting from Overuse of Republican River Supply in Nebraska
2005 and 2006

Prepared by

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January 20, 2009

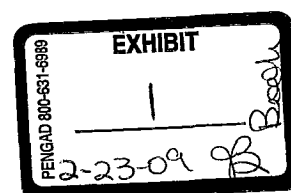


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Introduction

This report describes the analysis of reduced water supply to the State of Kansas caused by overuse of Nebraska's allocation on the Republican River for the years 2005 and 2006. The Republican River Compact allocates the available water supply of the Republican River Basin between the States of Kansas, Nebraska and Colorado. The Final Settlement Stipulation (FSS) and Accounting Procedures specify the methods to be used to quantify each State's Computed Beneficial Consumptive Use (CBCU) and allocation. For Water-Short Years, a two-year test of compliance is specified, in which the Nebraska CBCU is compared to its allocation upstream of Guide Rock. The analysis presented in this report was developed to determine how the water supply unavailable to the State of Kansas due to overuse in Nebraska for the two years would have been used if Nebraska had been in compliance with the FSS.

Nebraska's overuse upstream of Guide Rock for the two years totaled 78,960 ac-ft. This overuse was computed for the two years from the RRCA compact accounting (see Attachment 1). The figure for 2005 has been determined by the RRCA and confirmed by the ruling of the arbitrator with respect to the amount of non-Federal reservoir evaporation. The value for the year 2006 has not been agreed to by the States, due to differences in allocation of reservoir evaporation for Harlan County Reservoir (HCR). In addition, the 2006 number was updated since the December, 2007 submittal to the RRCA by Kansas, due to corrections in the RRCA accounting spreadsheet (see Attachments 1 and 2).

The overuse in Nebraska for the two years reduced the water supply available to the Kansas Bostwick Irrigation District (KBID). The KBID water supply from the Republican River is diverted at Guide Rock through the Courtland Canal. KBID calls for water from storage in Harlan County Reservoir (HCR). The actual water supply available to KBID for the two years (2005 – 2006) was limited by the water in storage at HCR, such that had Nebraska's total overuse been available at Guide Rock, it would have been diverted by KBID. This analysis derived the amount of water that would have been delivered to water users in the KBID service area. The additional supply would also have produced additional streamflow in the Republican River downstream of KBID lands, which would have resulted in additional diversions. Finally, additional flow would have reached Milford Reservoir downstream in Kansas. The results of this investigation have been provided to the Kansas economists for the purpose of computing economic damages to the state of Kansas due to the shortages caused by overuse in Nebraska.

This report describes the analysis and results of the use of additional water from the Republican River in Kansas for the two years, assuming no overuse in Nebraska. The analysis included the following components:

1. Determine the additional supply available to Kansas at the Stateline by deducting additional reservoir evaporation and transit loss between the Courtland Canal headgate and the Stateline.
2. Compare the available supply with the normal demand and existing supply in KBID.
3. Determine the amount of increased water supply at the farm in KBID, based on estimates of system losses in the Courtland Canal system.
4. Determine the return flows to the Republican River below KBID and estimate amounts considered divertable by downstream water users.

Additional Losses Above Stateline

It was assumed that the additional 78,960 ac-ft supply to Kansas would have been regulated through HCR. For purposes of this analysis, canal and lateral seepage and wasteway discharges and reservoir seepage and evaporation are collectively referred to as system losses. Based upon historical, 1994 – 2006, evaporation and supply data from the Bureau of Reclamation (BOR), the additional amount of evaporation was determined. BOR data for HCR are summarized in Appendix A. Gross evaporation was assumed to be a function of the HCR supply available before July of any given year. A relationship between gross and net evaporation rates was obtained independent of the supply. Over the two-year period, the additional supply to HCR resulted in an increase of approximately 4,000 ac-ft of net evaporation, assumed to be allocated to Kansas.

Additional transportation losses in Nebraska assigned to Kansas would have also occurred due to the additional supply. Only the consumptive portion of the Courtland Canal loss above the Stateline is allocated to Kansas. Losses and Courtland Canal diversions were tabulated from the RRCA accounting records for 1995 – 2006 (Appendix B). The average consumptive loss as a percentage of the Courtland Canal diversions was applied to the additional supply resulting in additional transportation losses of approximately 1,800 ac-ft for the two-year period.

Additional evaporation and transportation losses allocated to the State of Kansas and the resulting net Stateline supply were as follows:

**Additional Losses in Nebraska Assigned to Kansas
(2005 – 2006)
(ac-ft/yr)**

Year	Additional Supply	Additional HCR Evaporation	Additional Transportation Losses in NE	Net Available Stateline Supply
2005	42,900	1,300	1,000	40,600
2006	36,100	2,700	800	32,600

Note: Figures are rounded.

Description of KBID System

The Courtland Canal diverts from the Republican River near Guide Rock, Nebraska and delivers water to the KBID service area, located in Jewell and Republic Counties, west of Republic (See Figures 1-A and 1-B). The total service area is approximately 43,000 acres. Lovewell Reservoir, with a maximum capacity of approximately 56,000 ac-ft, is located in the service area and reregulates the Republican River supply from Courtland Canal. The service area consists of the upper section, approximately one-third of the service area above Lovewell, and the lower section, which receives water out of Lovewell. The Courtland Canal has a capacity of 530 cfs at the Nebraska Stateline and 440 cfs downstream of Lovewell. Courtland Canal is also operated outside of the irrigation season to supply water to Lovewell when needed. During the irrigation season, releases from HCR are made at the request of KBID and Nebraska Bostwick Irrigation District (NBID).

During 2005 and 2006, not all of the service area in KBID received water due to severe water supply shortages. KBID records document 23,400 acres irrigated in 2005 and 28,600 acres irrigated in 2006. For the lands actually receiving water, an average of approximately 6.6 inches were delivered in 2005 and 2006. KBID's base allocation is 15 inches.

Figure 1-A shows the location of the Courtland Canal and the Republican River below KBID lands. The KBID service areas are shown on Figure 1-B. Irrigation return flows from the KBID service area reach the Republican River and are available for diversion or recharge to the alluvial aquifer downstream.

Analysis of Additional Water Supply to KBID for 2005 and 2006

The amount of water available to KBID at the Stateline through the Courtland Canal, if Nebraska use had been within its allocation for the two years, was allocated to farm deliveries and system losses. Historical operational records were used to compute the efficiency of the Courtland Canal system to deliver water to the users served with project water in KBID. The additional water available to KBID water users at the farms was computed, using the efficiencies for canal, lateral and Lovewell Reservoir operations derived from historical records.

Records are available for water delivered into each of the two KBID sections (above and below Lovewell), discharges from canal and lateral wasteways, deliveries to the farms and computed canal loss. KBID also reports the acreage receiving water each year. These data for the period of 1994 - 2007 were compiled and used to derive loss relationships for each component, as a function of supply. This period was selected to provide a reasonable number of years with facilities and operations at current conditions in the district. Data for KBID water use over this period are included in Appendix C.

Efficiencies were developed separately for deliveries of water in the Upper and Lower KBID service area. Deliveries for the two years, as obtained from the annual reports of KBID, were as follows:

**KBID Data
(2005 and 2006)**

Upper KBID	2005	2006
Acres	0	5,925
Deliveries (ac-ft/yr)	0	3,023
Inches	0	6.1
Lower KBID		
Acres	23,439	22,654
Deliveries (ac-ft/yr)	11,299	14,711
Inches	5.8	7.8
Total KBID		
Acres	23,439	28,579
Deliveries (ac-ft/yr)	11,299	17,734
Inches	5.8	7.4

The acreage normally irrigated in KBID and farm deliveries, when adequate water supply is available to KBID, are indicated by supplies from 1994 to 2001. These averaged 38,000 acres and 13 inches per year over that period, or about 41,000 ac-ft/yr. Actual deliveries for 2005 and 2006 were approximately 28% and 43% of normal, respectively.

The system efficiency for delivery of the additional water supply to the farms was based on the delivery efficiency for the total supply. This was determined by applying the efficiencies derived from historical delivery records to the water supply that would have been available to KBID. Relationships of losses to water supply were derived separately for canal, lateral and Lovewell Reservoir (see Figures 2-6). It was necessary to allocate deliveries for the two sections above and below Lovewell, since the system losses are different for deliveries to each section, and reservoir losses are incurred for water delivered to the lower section. The historical data were used to determine this allocation. It should be noted that the amount of water determined to be delivered to the farms is independent of the actual acreage assumed to be irrigated, since the losses depend only on the allocation between the two KBID sections.

The analysis was made on a seasonal basis. The water supply for KBID is regulated through reservoir storage, providing KBID with the ability to use allocations when needed. Typically KBID water users take water during the months of May through September. It has been assumed that the water would be available to KBID from HCR during the irrigation season and reregulated through Lovewell as needed.

The percentage of canal loss was obtained from the relationships shown in Figures 2 and 4. Lateral losses were assumed to be 40% above Lovewell and 37% below Lovewell, based on the relationship of historical records shown in Figures 3 and 5. Some loss of water delivered to Lovewell Reservoir for use in the lower section was assumed, based on historical relationship of reservoir loss to supply. Annual losses were compared to supply, as shown on Figure 6. It was assumed that some reservoir loss would be incurred for additional supply at one-half of the derived annual rate, resulting in loss of approximately 8% of the water delivered to Lovewell.

Additional water supply computed to be available to KBID was added to the existing supply. The relationships of losses to water supply were used to compute canal, lateral and reservoir loss. After deducting these losses, the remaining supply available to the farms was computed. It should be noted that the records used for historical KBID operations were those prepared by the BOR, and indicated a small amount of delivery to the section above Lovewell in 2005, although the KBID records indicated no delivery in this section.

Summary of Additional KBID Supply

For the two years, the combined additional supply at the Stateline was 73,200 ac-ft. After deducting losses, computed as the additional losses, the farm deliveries for the two years would have increased by approximately 41,400 ac-ft. Table 1 is a summary of the results of the analysis of additional supply to KBID. Additional delivery to farms was computed to be 22,384 ac-ft in 2005 and 18,988 ac-ft in 2006.

KBID Return Flows

Water use at KBID causes stream gains due to return flows downstream of the district on the Republican River and tributaries. Return flows result from canal, lateral and field losses. Return flows consist of surface flows and deep percolation reaching the streams. Surface returns, termed wasteway flows, are measured and reported for the KBID service area. Canal and lateral losses are determined as the residual between water supply and deliveries to the farms. For purposes of this analysis, return flows were computed as the sum of canal, lateral losses and estimated on-farm return flows, computed based on estimated irrigation efficiencies. Return flows were applied to non KBID farms located downstream of the District to Concordia, KS in Cloud County.

The canal and lateral losses attributed to the additional water supply were determined as described above. To estimate the amount of return flow, 10% was deducted from the canal and lateral losses (excluding measured wasteway discharge), to account for evaporation. The total return flows, including wasteways, transit losses, and farm percolation, were then reduced by five percent to account for transmission loss reaching the Republican River and tributaries. The increased return flows from KBID would have been available to downstream water users.

Total return flows from KBID attributable to the additional supply, was computed to be approximately 20,200 ac-ft in 2005 and approximately 15,000 ac-ft in 2006. Return flows from KBID were assumed to be available in the year they occurred.

Republican River water rights were under Minimum Desirable Streamflow (MDS) administration the entire 2005 and 2006 period, respectively. The additional water from KBID return flows were added to historical flows at Concordia and compared to MDS for the period. Based on records and discussions with Kansas officials, the additional flows would not have been enough to remove MDS in either 2005 or 2006.

Non-KBID farms would have used more irrigation water had it been available. Active irrigation surface water rights senior to MDS that were short in 2005 and 2006 were identified and are summarized in Appendix D. Water rights were limited to those located between Spring Creek and Concordia, KS, including rights on the mainstem and tributaries. The total maximum ac-ft used for the 1994 – 2004 period was calculated. Computed additional diversions that would have been used by senior irrigators from KBID return flows in 2005 and 2006 totaled approximately 9,100 ac-ft for the two-year period.

The net additional flow available at Concordia was estimated to be 15,800 in 2005 and 10,300 ac-ft in 2006. This water would flow to Milford Reservoir, which is located approximately 58 miles downstream of Concordia. Table 2 is a summary of the derivation of the additional supply in Kansas from the overuse in Nebraska.

Summary

In summary, water users in Kansas would have received approximately 41,400 acre-ft on the KBID lands and diverted approximately 9,100 ac-ft to senior irrigators in 2005 and 2006 if the 78,960 acre-ft of overuse in Nebraska had been received at the Stateline. The analysis of additional diversions is summarized as followed:

**Additional Water Supply in Kansas
(2005 – 2006)
(ac-ft/yr)**

	2005	2006	Total
KBID	22,400	19,000	41,400
Downstream Senior Water Rights	4,400	4,700	9,100
Total	26,800	23,700	50,500

Figures

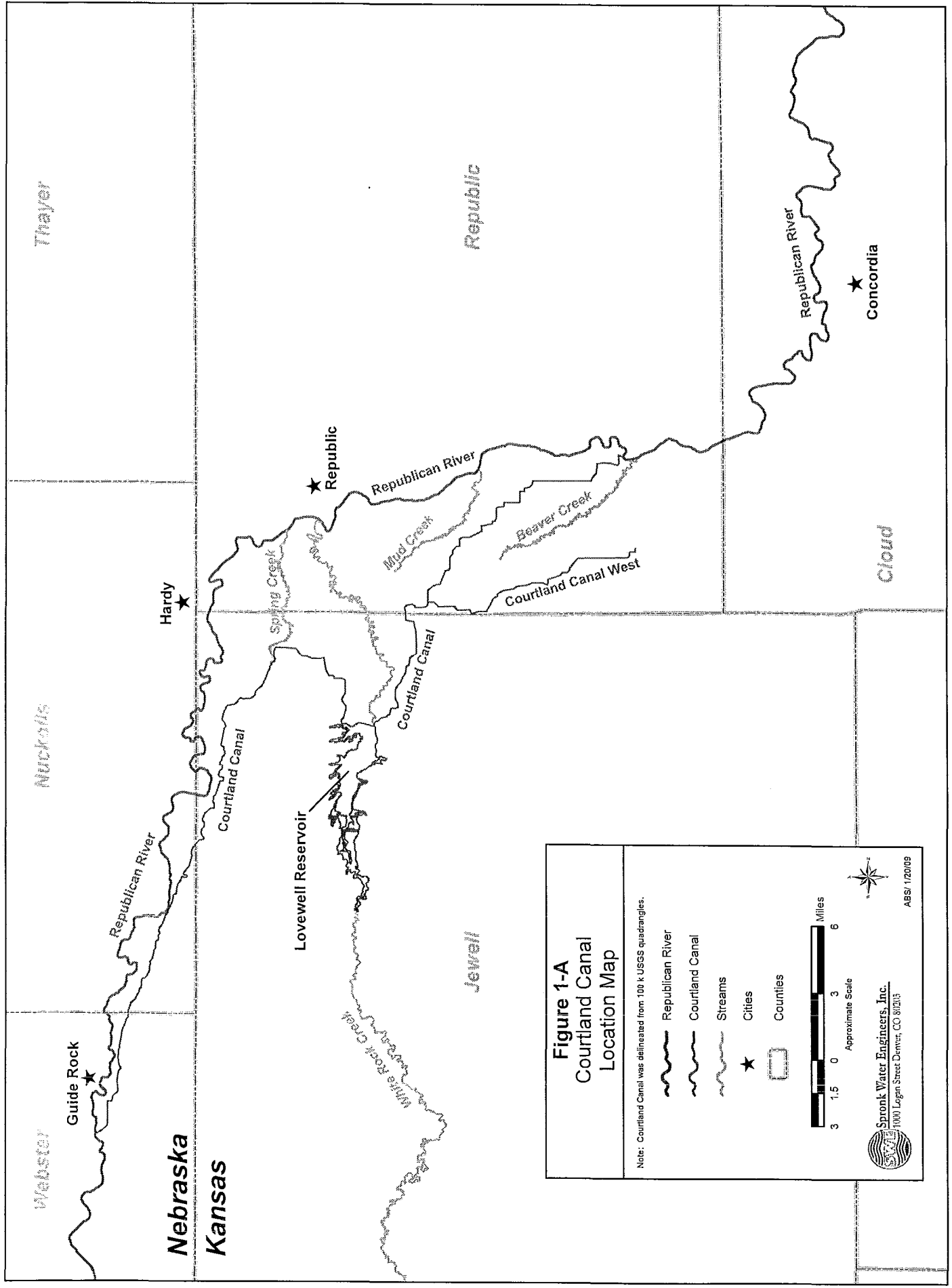



Figure 1-A
Courtland Canal
Location Map

Note: Courtland Canal was delineated from 100 k USGS quadrangles.

Legend:
Republican River
Courtland Canal
Streams
Cities
Counties

Scale: 3 1.5 0 3 6 Miles
Approximate Scale


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ABS: 1/20/09

Figure 1-B

part of
Great Plains Region
UNITED STATES
DEPARTMENT OF AGRICULTURE
BUREAU OF RECLAMATION
LOWER MISSOURI REGION

PICK-SLOAN MISSOURI BASIN PROGRAM
BOSTWICK DIVISION
NEBRASKA-KANSAS

MAP NO. 271-776-3323
SCALE OF MILES
0 5 10
1961

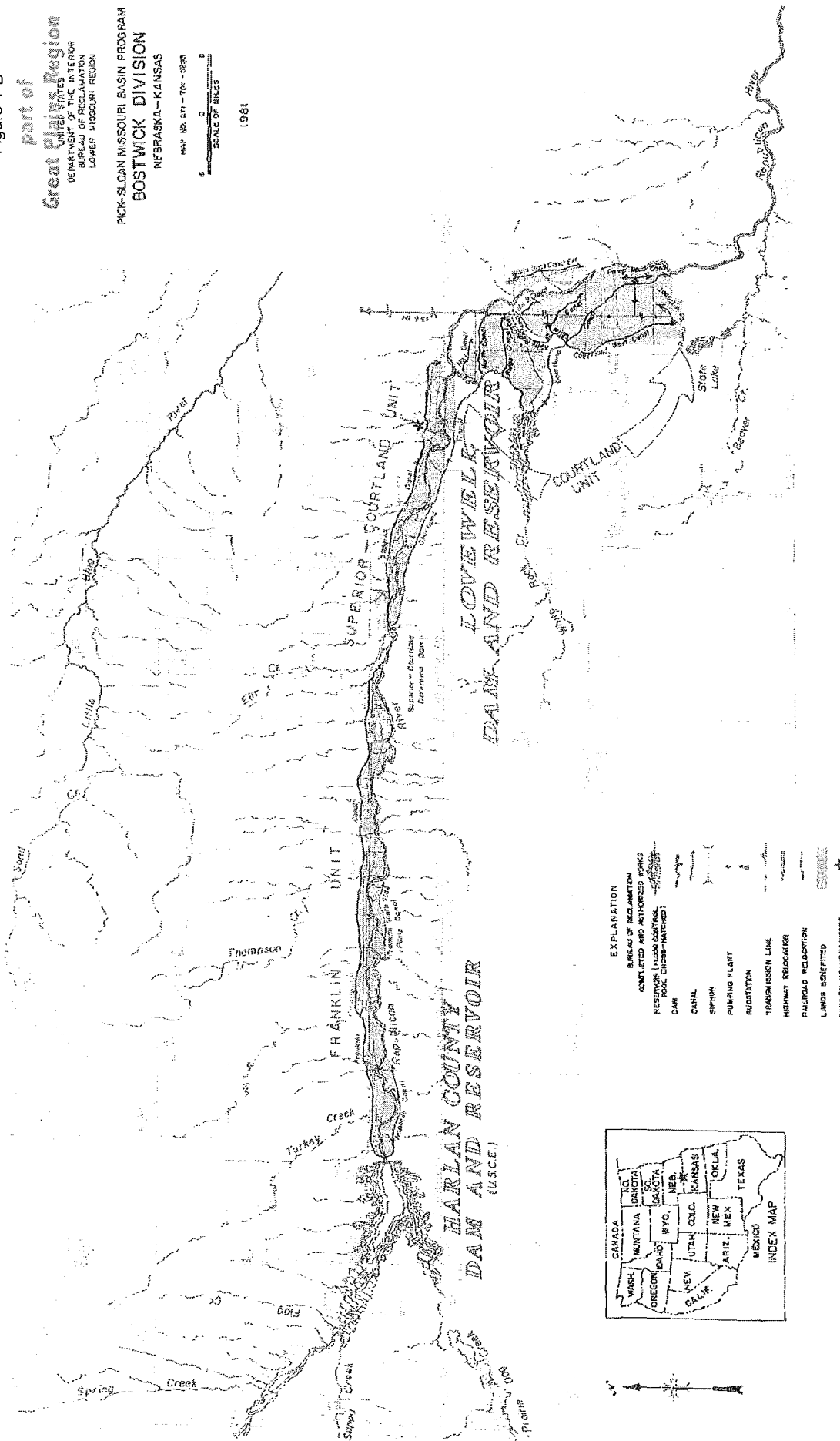


Figure 2
Above Lovewell Canal Loss vs Courtland Canal at
Nebraska-Kansas Stateline

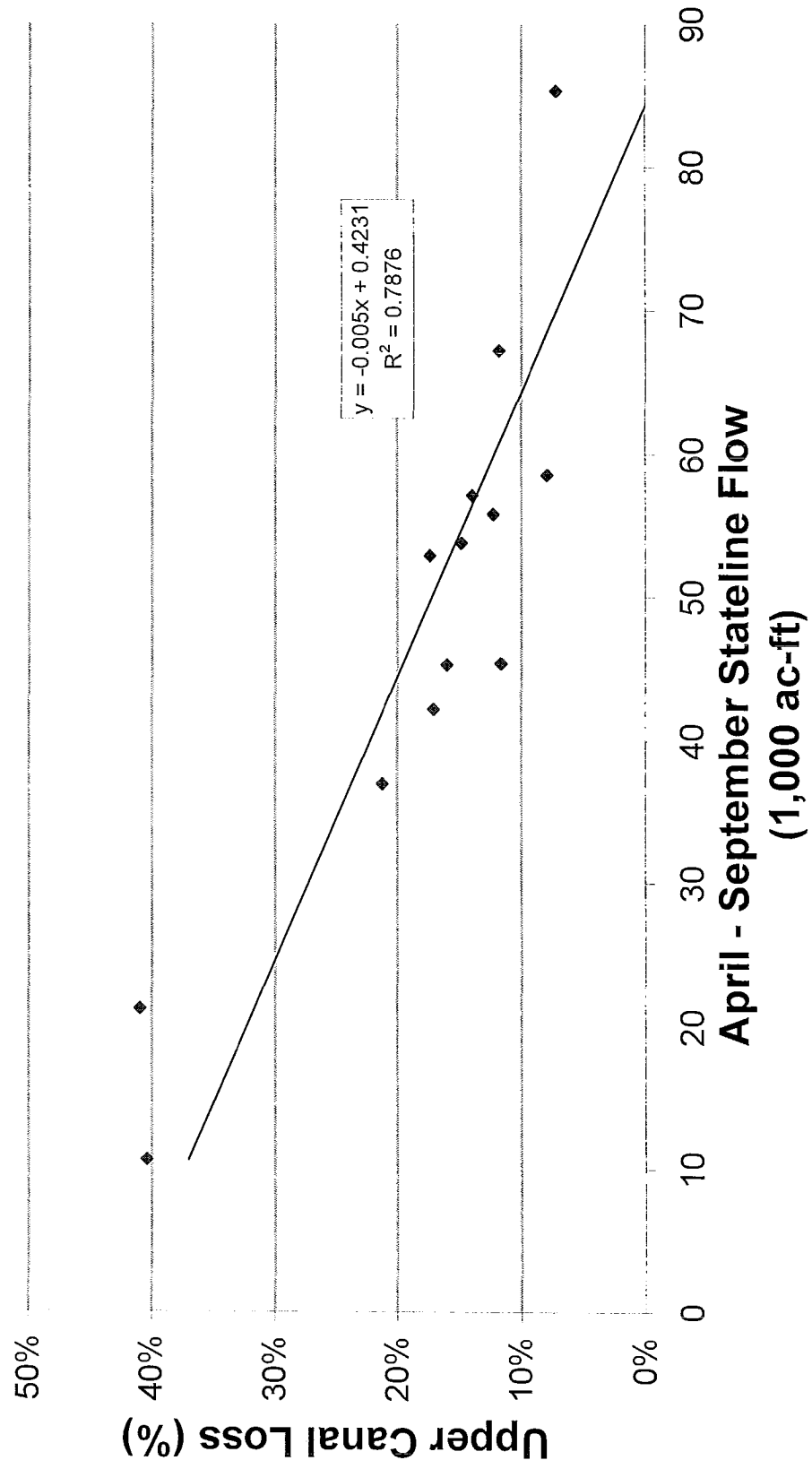


Figure 3
Above Lovewell Lateral Losses vs Supply

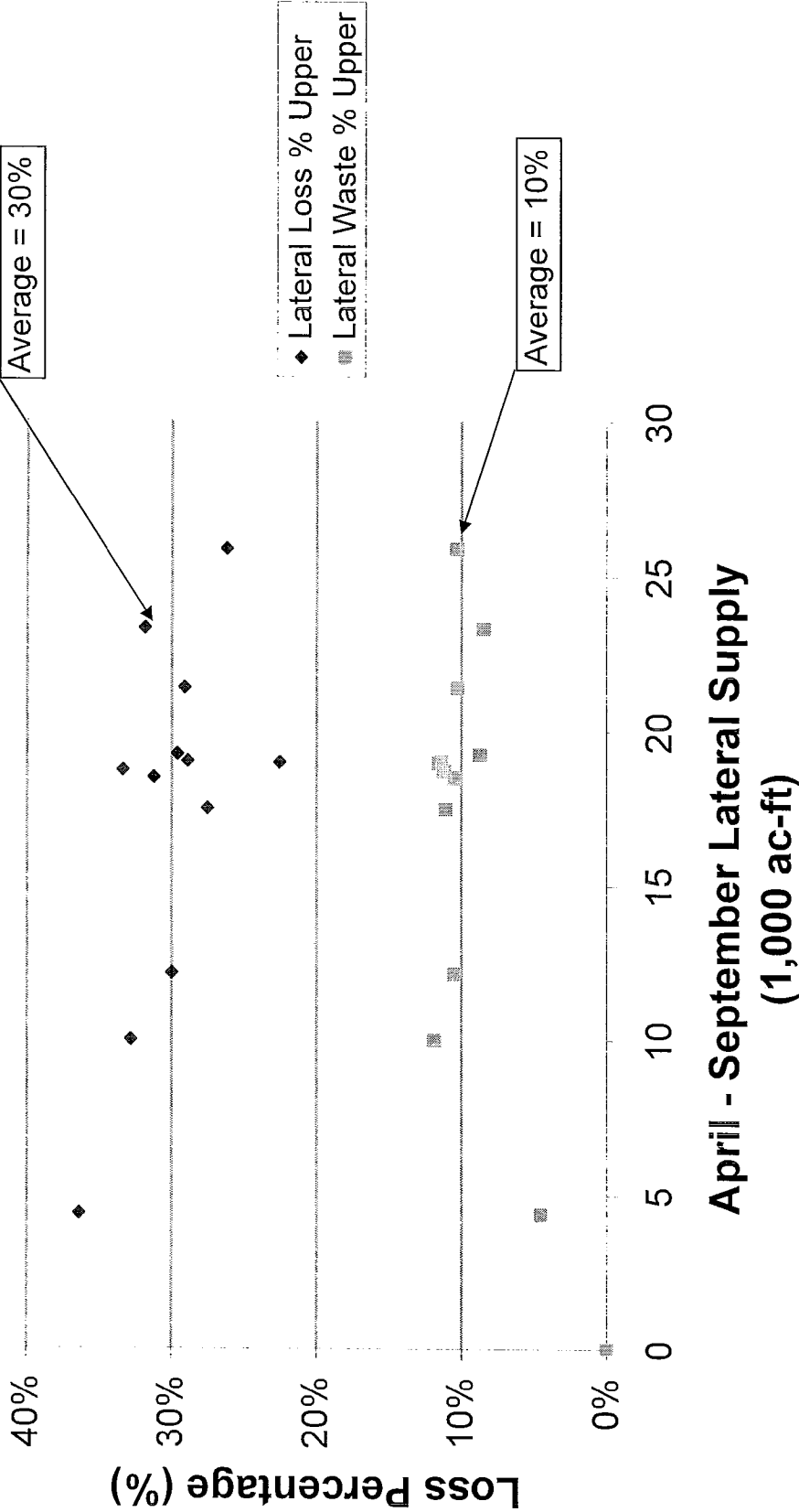


Figure 4
Lovewell Reservoir Release vs Below Lovewell Canal Loss

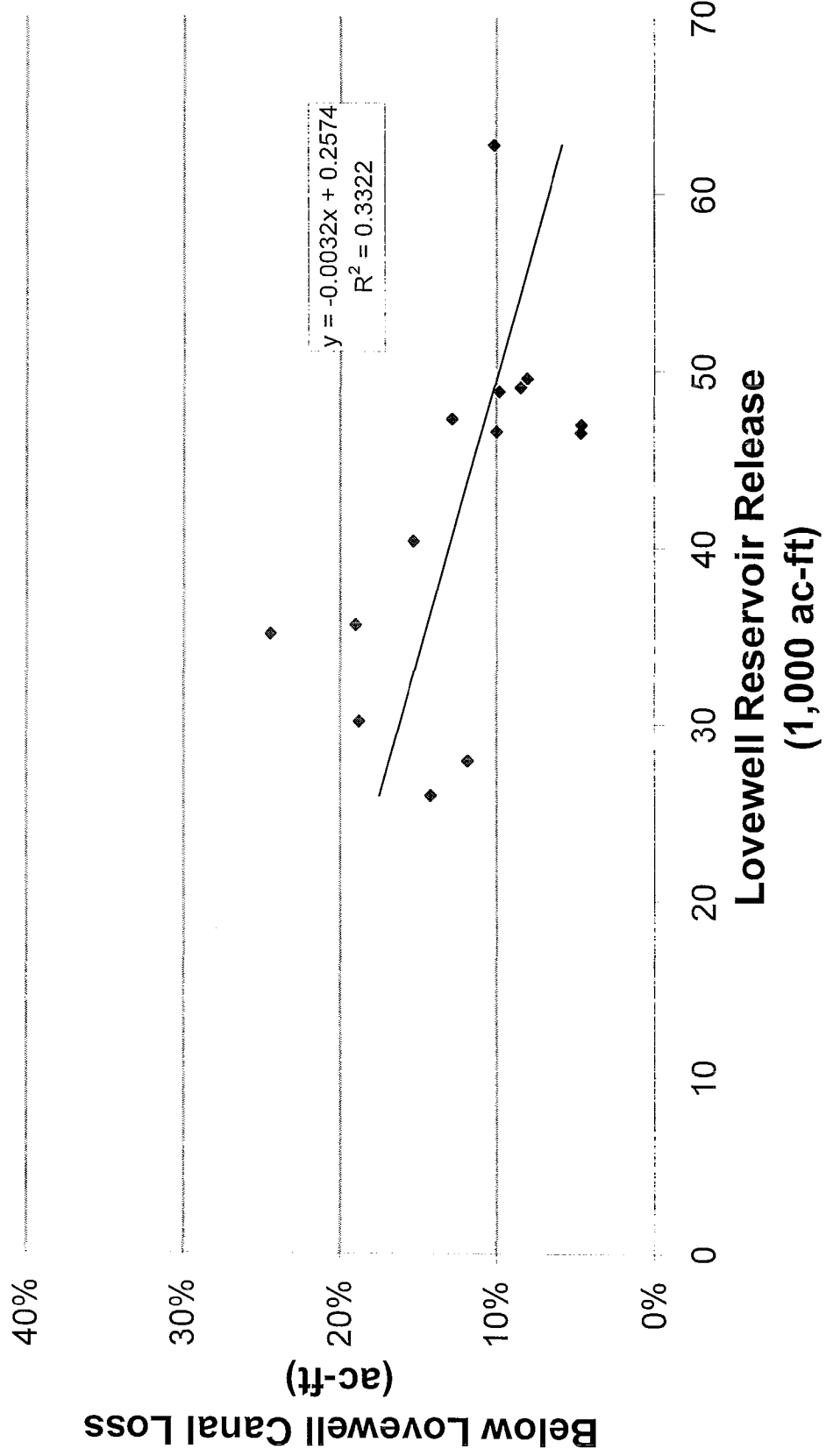


Figure 5
Below Lovewell Lateral Loss vs Supply

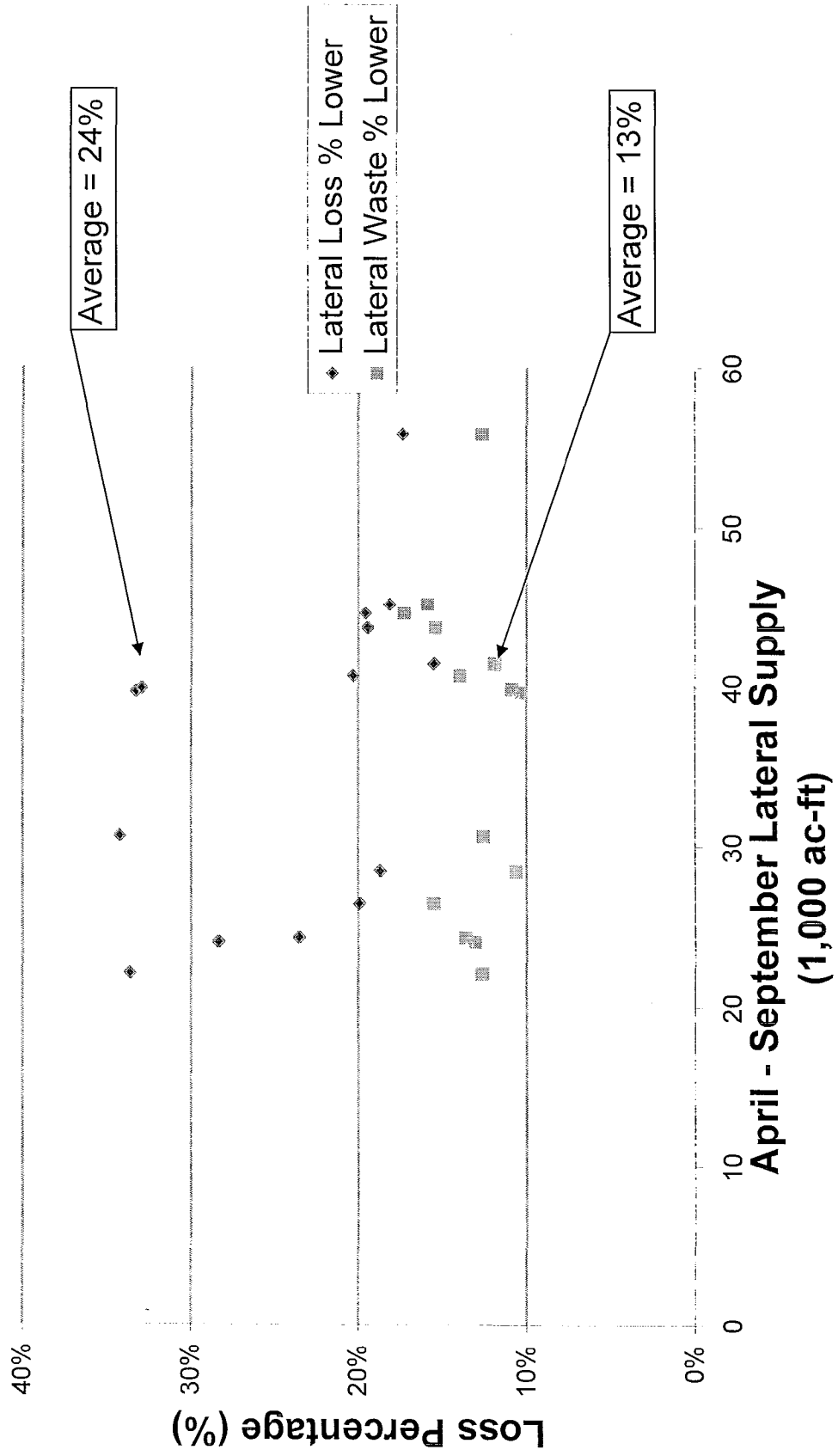
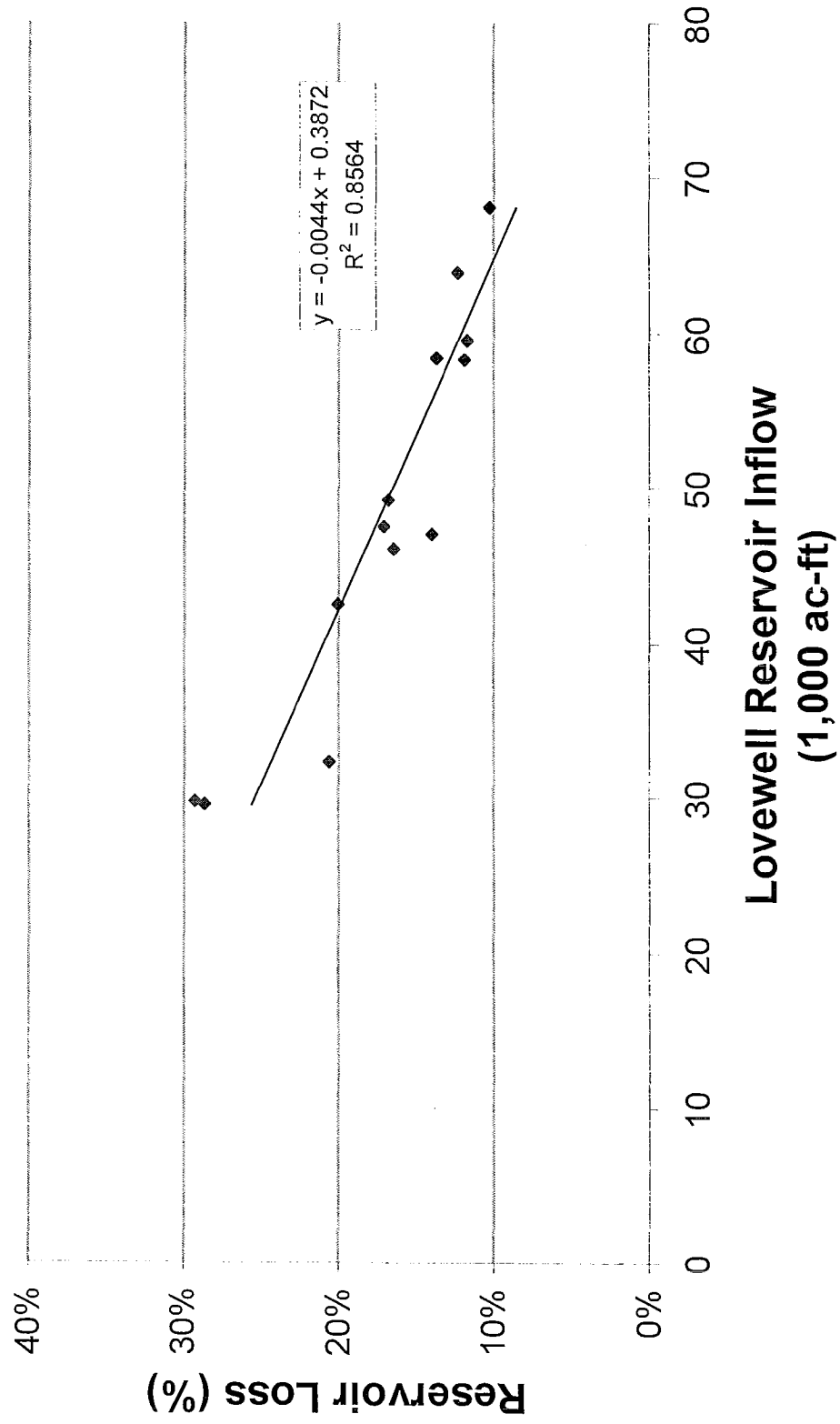


Figure 6
Reservoir Loss vs Lovewell Reservoir Inflow



Tables

Table 1
Summary of KBID Water Supply Analysis
(ac-ft)

		Historical		Modeled		Incremental	
April - September Water Year		2005	2006	2005	2006	2005	2006
Above Lovewell (Apr-Sep WY)	Courtland Canal at Nebraska-Kansas Stateline	19,301	21,147	59,901	53,747	40,600	32,600
	Courtland Canal Loss Above Lovewell Reservoir	2,675	8,649	7,403	8,297	4,728	-353
	Courtland Canal Waste Above Lovewell Reservoir	0	0	0	0	0	0
	Courtland Canal Water Diverted by Upper Main Farm Headgate Delivery and Upper Laterals	561	5,154	52,498	45,451	51,937	40,297
	Upper Main Farm Headgate Delivery	561	759	1,220	1,289	659	530
	Upper Lateral Diversion	0	4,395	17,146	18,110	17,146	13,715
	Upper Lateral Waste	0	201	1,720	1,816	1,720	1,615
	Upper Lateral Loss	0	1,600	5,139	5,427	5,139	3,827
	Upper Lateral Farm Headgate Delivery	0	2,594	10,288	10,866	10,288	8,272
	Delivery to Lovewell Reservoir	16,065	7,344	34,131	26,052	18,066	18,708
Lovewell (Annual)	Courtland Canal Inflow	27,908	18,663	45,974	37,371	18,066	18,708
	Whiterock Creek Inflow	14,139	11,390	14,139	11,390	0	0
	Non-Courtland Canal Release	443	-322	443	-322	0	0
	Net Inflow	42,490	29,731	60,556	48,439	18,066	18,708
	Estimated Net Loss	-8,528	-8,701	-9,838	-10,510	-1,310	-1,809
Below Lovewell (Apr-Sep WY)	Release to Courtland Canal	25,916	27,851	42,672	44,750	16,756	16,899
	Release from Lovewell Reservoir	25,916	27,851	42,672	44,750	16,756	16,899
	Courtland Canal Loss Below Lovewell Reservoir	3,684	3,300	5,521	5,511	1,837	2,211
	Courtland Canal Waste Below Lovewell Reservoir	0	0	0	0	0	0
	Courtland Canal Water Diverted by Lower Main Farm Headgate Delivery and Lower Laterals	22,232	24,551	37,151	39,239	14,919	14,688
	Lower Main Farm Headgate Delivery	179	532	383	405	204	-127
	Lower Lateral Diversion	22,053	24,019	36,768	38,834	14,715	14,815
	Lower Lateral Waste	2,779	3,133	4,883	5,157	2,104	2,024
	Lower Lateral Loss	7,413	6,808	8,791	9,285	1,378	2,477
	Lower Lateral Farm Headgate Delivery	11,861	14,078	23,094	24,392	11,233	10,314
Total Farm Delivery		12,601	17,963	34,985	36,951	22,384	18,988

Table 2
Derivation of Additional Supply in Kansas from Overuse in Nebraska
(ac-ft)

Description	2005	2006	Total
Overuse in Nebraska	42,860	36,100	78,960
HCR Evaporation and Transportation Losses in NE	2,309	3,495	5,804
Net Available Stateline Supply	40,551	32,605	73,156
KBID Losses			
Canal	6,565	1,858	8,423
Lateral	10,341	9,945	20,286
Reservoir	1,310	1,809	3,119
KBID Farm Deliveries			
Above Lovewell	10,947	8,801	19,748
Below Lovewell	11,437	10,187	21,624
Total	22,384	18,988	41,372
(1) KBID Return Flows	22,573	16,611	39,184
(2) Return Flow Losses	2,371	1,606	3,977
(3) Net Return Flows to Stream	20,202	15,005	35,207
(4) Downstream Diversions	4,431	4,693	9,124
(5) Additional Flow Available at Concordia	15,771	10,312	26,083

Notes:

- (1) Sum of canal, lateral losses and estimated on-farm return flows, computed based on estimated irrigation efficiencies
- (2) Assumed a 5% transmission loss on all return flows and a 10% evaporation loss on canal and lateral losses
- (3) Net Return Flows to Stream = (1) - (2)
- (4) Additional surface diversions by irrigators senior to the minimum desirable streamflow
- (5) Additional Flow Available at Concordia = (3) - (4)

Appendix A

Harlan County Reservoir

Historical Evaporation and Supply:

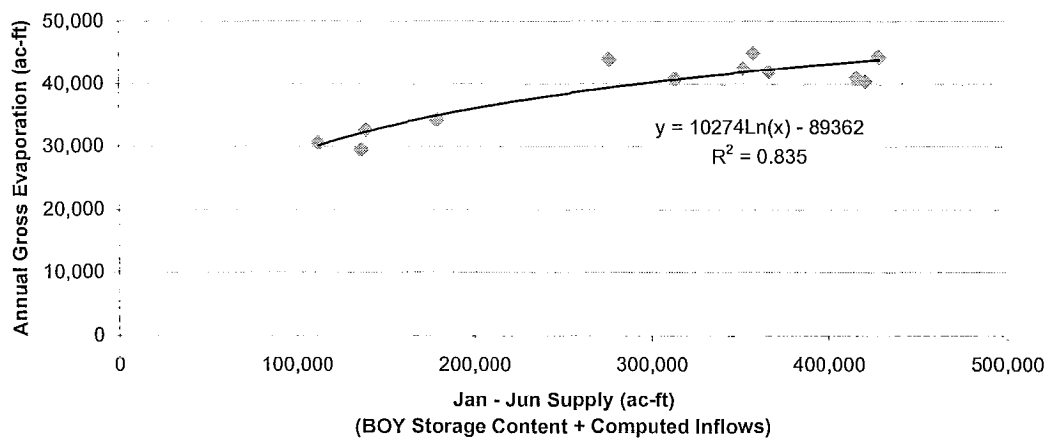
1994 - 2006

Appendix A
Harlan County Reservoir (HCR)
Historical Evaporation and Supply: 1994 - 2006

Seasonal Summary					
Year	Annual Gross Evap ac-ft	Annual Net Evap ac-ft	Net Evap / Gross Evap %	Seasonal Supply (Jan-Jun) ac-ft	Gross Evap as a % of Supply %
1994	44,383	22,959	52%	429,012	10.3%
1995	40,356	14,953	37%	421,540	9.6%
1996					
1997	40,920	20,010	49%	416,669	9.8%
1998	41,929	16,666	40%	367,157	11.4%
1999	42,472	15,242	36%	352,906	12.0%
2000	45,006	20,422	45%	358,365	12.6%
2001	40,833	12,341	30%	314,505	13.0%
2002	43,988	29,526	67%	276,593	15.9%
2003	34,307	21,793	64%	179,391	19.1%
2004	30,601	17,013	56%	112,696	27.2%
2005	32,621	17,705	54%	139,441	23.4%
2006	29,609	16,298	55%	136,776	21.6%
Total	467,025	224,928	48%	3,505,051	13.3%

Source: Bureau of Reclamation HYDROMET database

Harlan County Reservoir
Gross Evaporation vs Supply
1994 - 2006
(ac-ft)



Additional HCR Evaporation Analysis (ac-ft)

Year	Additional Supply	Adjusted Supply	Adjusted Gross Evap	Additional Net Evap	Adjusted Supply Less Net Evap
2005	42,860	182,301	35,091	1,341	41,519
2006	36,100	172,876	34,546	2,717	33,383

Appendix B

Courtland Canal Headgate

Diversions and Losses in Nebraska:

1995 - 2006

Appendix B
Courtland Canal Headgate Diversions and Losses in Nebraska
1995 - 2006
ac-ft

Year	Courtland Canal Diversions	Losses in NE Assigned to KS			Transportation Losses that do not Recharge (18%)				
		Upper Courtland	Delivery to Lovewell	Total	% of Canal Diversions	Upper Courtland	Delivery to Lovewell	Total	% of Canal Diversions
1995	62,772	3,505	86	3,591	5.7%	631	15	646	1.0%
1996	72,949	2,317	3,498	5,815	8.0%	417	630	1,047	1.4%
1997	67,626	3,485	4,516	8,001	11.8%	627	813	1,440	2.1%
1998	65,785	3,333	4,259	7,592	11.5%	600	767	1,367	2.1%
1999	62,291	3,866	3,044	6,910	11.1%	696	548	1,244	2.0%
2000	126,839	2,687	9,574	12,261	9.7%	484	1,723	2,207	1.7%
2001	61,217	4,064	4,419	8,483	13.9%	732	795	1,527	2.5%
2002	87,742	3,704	8,002	11,706	13.3%	667	1,440	2,107	2.4%
2003	66,500	2,841	10,116	12,957	19.5%	511	1,821	2,332	3.5%
2004	31,501	184	5,877	6,061	19.2%	33	1,058	1,091	3.5%
2005	48,737	415	8,236	8,651	17.8%	75	1,482	1,557	3.2%
2006	50,631	2,242	9,916	12,158	24.0%	404	1,785	2,189	4.3%
Average	67,049	2,720	5,962	8,682	12.9%	490	1,073	1,563	2.3%

Source: RRCA Accounting spreadsheets

Analysis of the Additional Transportation Losses in Nebraska Assigned to Kansas (ac-ft)

Year	Adjusted Supply Less Net Evap	Additional Transportation Losses	Adjusted Supply Less Transportation Loss
2005	41,519	968	40,600
2006	33,383	778	32,600

Appendix C

KBID Water Use Data

1/20/2009

Appendix C KBID Water Use Data

Table C1 of 5
Courtland Canal at Stateline
acre-ft

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994													
1995	9	0	0	3,977	2,300	0	0	0	12,621	15,311	16,312	483	45,227
1996	2,374	0	0	0	0	0	1,111	0	2,866	20,466	21,761	12,206	63,386
1997	0	0	0	0	0	0	0	8,097	10,090	23,790	20,250	3,854	69,566
1998	4,310	17	0	0	0	15	123	3,636	8,372	21,128	15,787	4,837	53,760
1999	0	0	0	0	0	0	0	284	12,024	22,959	15,479	4,933	60,145
2000	188	0	0	0	0	11,502	6,462	378	9,019	21,973	14,097	7,391	52,857
2001	3,802	4,665	4,612	4,633	762	0	0	4,195	17,971	28,459	23,965	4,282	98,202
2002	5,623	61	0	0	0	0	3,881	6,510	6,898	15,999	14,946	8,836	63,831
2003	3,834	4,788	4,364	3,898	2,512	0	4,110	5,645	4,171	12,074	8,410	2,479	64,198
2004	2,128	2,926	3,320	3,640	1,914	1,515	4,552	3,078	1,004	1,728	39	185	56,284
2005	1,525	2,156	2,537	1,987	4,233	4,665	5,867	4,261	5,359	770	1,900	1,144	26,031
2006	1,644	2,206	2,220	3,134	2,694	3,767	4,413	2,630	3,431	8,181	1,134	1,359	36,811
2007	1,795	2,634	2,912	2,727	2,918	4,261	4,709	5,643	4,473	12,256	10,977	4,104	59,408
Average	2,093	1,496	1,536	1,714	1,324	1,838	2,516	3,204	7,391	16,361	12,837	4,207	56,151

Source: USGS Gage #06852500, Courtland Canal at Nebraska-Kansas Stateline

Table C2 of 5
Above Lovewell Reservoir Farm Delivery
acre-ft

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994													
1995	0	0	0	0	0	0	0	0	2,490	2,768	6,172	37	11,467
1996	0	0	0	0	0	0	0	0	13	8,250	6,073	1,085	15,421
1997	0	0	0	0	0	0	0	0	3,331	5,870	4,517	214	13,932
1998	0	0	0	0	0	0	0	0	422	7,841	3,402	222	11,887
1999	0	0	0	0	0	0	0	0	2,211	5,827	4,475	204	12,717
2000	0	0	0	0	0	0	0	0	1,017	9,301	3,653	429	14,400
2001	0	0	0	0	0	0	0	124	4,626	7,475	6,048	70	18,343
2002	0	0	0	0	0	0	0	0	1,277	3,340	6,635	742	11,994
2003	0	0	0	0	0	0	0	0	1,854	7,944	3,588	0	13,386
2004	0	0	0	0	0	0	0	0	0	5,363	3,012	0	8,375
2005	0	90	0	0	0	0	0	0	0	43	11	0	54
2006	0	0	0	0	0	0	0	0	373	125	63	0	651
2007	0	0	0	0	0	0	0	15	274	2,765	258	41	3,353
Average	0	7	0	0	0	0	0	10	1,282	5,013	3,597	217	10,126

Source: US Bureau of Reclamation

1/20/2009

Appendix C KBID Water Use Data

Table C3 of 5
Inflow to Lovewell Reservoir
acre-ft

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994				0	0	0	0	0	3,536	7,657	6,369	607	18,169
1995	0	0	0	3,490	2,060	0	0	0	837	3,813	10,199	9,450	29,849
1996	1,990	0	0	0	0	0	105	4,875	2,207	14,724	13,192	3,746	40,839
1997	0	0	0	0	0	0	0	2,476	4,180	7,180	8,609	3,731	26,176
1998	3,626	0	0	0	0	0	0	0	4,742	12,075	7,876	3,877	32,196
1999	0	0	0	0	0	0	0	0	2,888	7,234	6,614	4,115	20,851
2000	0	0	0	0	835	10,025	6,825	1,838	7,668	16,875	14,631	3,563	62,260
2001	3,130	4,092	3,997	4,027	764	0	0	0	1,324	8,933	4,356	6,713	37,336
2002	4,792	0	0	0	0	0	3,043	5,470	1,666	11,412	9,023	2,488	37,914
2003	3,572	3,878	3,581	3,355	1,740	0	3,167	4,232	1,426	2,061	3,288	1,582	31,882
2004	1,189	2,006	2,550	2,685	1,398	1,128	3,776	2,150	104	230	0	0	17,216
2005	0	831	1,828	1,804	3,430	3,950	5,677	3,749	4,164	0	1,562	913	27,908
2006	884	1,512	1,620	2,473	1,968	2,862	3,509	1,004	478	1,863	91	399	18,663
2007	873	1,611	1,964	2,047	4,076	3,602	3,941	4,447	1,806	5,318	5,975	3,227	38,887
Average	1,543	1,072	1,195	1,420	1,162	1,541	2,146	2,160	2,646	7,098	6,556	3,172	31,439

Source: US Bureau of Reclamation Annual Operating Plans

Table C4 of 5
Releases from Lovewell Reservoir
acre-ft

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994				0	0	0	0	1,254	7,744	11,560	19,706	97	40,351
1995	0	0	0	0	0	0	0	484	2,176	18,839	19,603	5,391	46,493
1996	0	0	0	0	0	0	0	424	13,049	17,219	14,737	1,517	46,946
1997	0	0	0	0	0	0	0	607	6,514	24,679	15,204	1,827	48,831
1998	0	0	0	0	0	0	0	369	12,347	19,286	14,912	2,144	49,058
1999	0	0	0	0	0	0	0	246	5,461	26,946	13,831	3,086	49,570
2000	0	0	0	0	0	0	0	2,033	15,007	24,088	21,327	290	62,745
2001	0	0	0	0	0	0	0	0	6,748	16,166	20,619	3,711	47,244
2002	0	0	0	0	0	0	0	0	9,697	24,676	12,184	0	46,557
2003	0	0	0	0	0	0	0	472	3,647	19,015	12,472	0	35,606
2004	0	0	0	0	0	0	0	982	1,417	9,713	18,022	0	30,134
2005	0	0	0	0	0	0	0	0	4,310	14,572	7,034	0	25,916
2006	0	0	0	0	0	0	0	492	4,796	13,730	8,839	0	27,851
2007	0	0	0	0	0	0	0	1,895	4,637	15,064	13,505	0	35,101
Average	0	0	0	0	0	0	0	661	6,968	18,254	15,142	1,290	42,315

Source: US Bureau of Reclamation

Appendix C
KBID Water Use Data

Table C5 of 5
Below Lovewell Reservoir Farm Delivery
acre-ft

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994									1,928	4,978	12,842	115	19,863
1995	0	0	0	0	0	0	0	0	11	11,613	12,454	2,975	27,053
1996	0	0	0	0	0	0	0	0	7,793	10,725	8,252	547	27,317
1997	0	0	0	0	0	0	0	0	1,659	17,580	8,802	777	28,818
1998	0	0	0	0	0	0	0	0	6,715	12,267	8,609	884	28,475
1999	0	0	0	0	0	0	0	0	1,162	19,708	7,757	1,586	30,213
2000	0	0	0	0	0	0	0	285	9,122	16,891	13,212	163	39,673
2001	0	0	0	0	0	0	0	0	2,676	8,920	13,661	1,983	27,240
2002	0	0	0	0	0	0	0	0	4,529	18,064	7,973	0	30,566
2003	0	0	0	0	0	0	0	0	0	12,118	8,372	0	20,490
2004	0	0	0	0	0	0	0	0	0	4,043	11,413	0	15,456
2005	0	0	0	0	0	0	0	0	1,394	7,353	3,293	0	12,040
2006	0	0	0	0	0	0	0	0	1,601	7,310	5,599	0	14,610
2007	0	0	0	0	0	0	0	0	196	8,735	8,233	0	17,164
Average	0	0	0	0	0	0	0	20	2,770	11,450	9,327	645	24,213

Source: US Bureau of Reclamation

Appendix D

Republican River Active

Surface Water Rights Senior to the

Minimum Desirable Streamflow (MDS)

Appendix D
Republican River Active Surface Water Rights Senior to the Minimum Desirable Streamflow (MDS)
ac-ft used

Pdiv_ID	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Max 1994 - 2004	Averages			Authorized Quantity
														Period	1994 - 2004	2005 - 2006		
48016	8.0	57.9	14.1	24.7	21.2	21.2	28.5	21.2	24.7	6.5	22.1	29.6	0.0	57.9	21.4	22.6	14.8	70
10073	11.9	0.0	21.2	28.3	21.2	24.7	28.3	23.3	31.8	24.3	29.5	46.9	0.0	31.8	22.4	22.2	23.5	70
23052	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.2	0.0	29.8	6.7	12.2	3.7	1.1	18.2	82
45387	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	82
17379	38.7	58.9	70.0	68.1	68.1	70.0	66.3	68.1	68.1	51.7	31.1	19.0	38.2	70.0	55.1	59.9	28.6	70
3052	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	212
1867	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	212
51273	0.0	113.7	88.1	107.6	111.4	119.0	173.2	128.8	241.7	393.9	85.8	0.0	0.0	393.9	120.3	142.1	0.0	212
37038	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150
32412	0.0	0.0	71.6	0.0	0.0	75.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	75.1	11.3	13.3	0.0	150
18701	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30
54870	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73
35640	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30
51169	0.0	0.0	0.0	0.0	54.9	73.6	115.3	83.5	120.7	85.6	78.6	68.5	25.1	120.7	54.3	55.7	46.8	83
32430														0.0				0
6592	71.4	124.6	84.5	80.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	124.6	27.8	32.8	0.0	83
11473	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83
36486	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83
45868														0.0				0
35713	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83
33557	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83
5069	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83
72714														45.0	0.0	45.0	45.0	45
32416	0.0	0.0	0.0	0.0	0.0	0.0	60.4	0.0	0.0	0.0	0.0	0.0	0.0	60.4	5.0	5.5	0.0	0
22251	21.2	31.8	37.1	42.4	47.1	53.8	0.0	57.4	81.9	52.4	47.2	52.3		61.9	42.1	41.1	52.3	0
46853	17.7	23.9	23.7	34.5	22.3	54.3	44.2	46.8	67.0	0.0	87.5	128.0	135.4	87.5	52.7	38.3	131.7	23
42109	30.2	55.2	54.3	57.1	46.0	47.9	48.6	51.6	47.9	72.0	0.0	0.0	0.0	72.0	39.3	46.4	0.0	23
10675	61.7	160.8	20.5	32.3	81.7	44.1	92.2	73.6	85.4	13.3	0.9	70.8	67.6	160.8	61.9	60.6	69.2	135
2333	0.0	0.0	41.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.8	3.2	3.8	0.0	135
4575	0.0	0.0	77.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	77.2	5.9	7.0	0.0	135
75478														0.0				144
22527	11.4	26.1	17.0	17.3	22.5	20.5	27.3	28.1	34.1	50.2	31.1	51.2	29.8	50.2	28.2	26.0	40.5	0
19262	6.6	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.8	1.2	1.4	0.0	42
2645	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42
483	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87
103	0.0	25.0	21.8	0.0	31.1	26.2	28.9	27.3	24.3	23.8	24.1	0.0	0.0	31.1	17.9	21.1	0.0	24
18685	20.3	30.4	30.4	0.0	50.6	35.0	38.0	46.4	47.7	64.9	41.3	58.2	58.1	64.9	40.1	36.8	58.1	58
38423	44.5	75.0	24.9	18.7	69.2	92.4	124.8	90.3	58.4					124.8	67.1	67.1	0	0
38611	0.0	0.0	0.0	0.0	0.0									0.0	0.0	0.0	0.0	0
69744										0.0	56.3	55.1	55.7	56.3	41.8	28.2	55.4	56
28985	39.3	0.0	49.1	0.0	13.7	0.0	0.0	0.0	0.0	0.0	0.0	17.0	20.6	49.1	10.7	9.3	18.8	62
15957	18.7	0.0	0.0	0.0	0.0	61.5	0.0	0.0	0.0	64.2	6.2	0.0	0.0	64.2	11.6	13.7	0.0	62
35640	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30
45387	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	82
23052	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.2	0.0	29.8	6.7	12.2	3.7	1.1	18.2	82
47289	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33
32182	25.8	9.7	20.7	29.7	13.8	13.8	13.8	16.6	15.2	0.0	0.0	27.0	21.0	29.7	15.9	14.5	24.0	33
24903	35.8	30.5	41.4	53.9	58.3	104.4	136.2	80.5	94.8	41.3	30.0	42.9	63.1	136.2	63.0	64.8	53.0	120
16398	0.0	36.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.3	2.8	3.3	0.0	120
3993	0.0	27.8	0.0	52.1	0.0	0.0	73.4	70.3	90.4	0.0	27.8	29.2	37.2	90.4	31.4	31.1	33.2	69
17872	149.1	214.4	100.6	101.3	74.6	303.8	334.2	324.1	322.0	210.0	108.0	40.0	47.0	334.2	179.2	203.8	43.5	293
20554	73.7	70.0	73.7	117.8	154.7	151.0	165.7	156.5	165.7	85.0	102.0	74.0	34.0	165.7	109.5	119.6	54.0	120
30705														0.0				0
9191	2.7	51.3	30.9	50.2	31.0	31.0	28.8	31.0	22.1	35.1	15.6	9.5	0.0	51.3	26.1	30.0	4.7	31
20554	73.7	70.0	73.7	117.8	154.7	151.0	165.7	156.5	165.7	85.0	102.0	74.0	34.0	165.7	109.5	119.6	54.0	120
17872	149.1	214.4	100.6	101.3	74.6	303.8	334.2	324.1	322.0	210.0	108.0	40.0	47.0	334.2	179.2	203.8	43.5	293
53916	0.0	0.0	0.0	3.9	0.0	0.0	0.0	11.9	28.0	14.1	0.0	7.6	9.7	28.0	5.8	5.3	8.6	34
33523	14.4	23.0	25.3	20.7	33.6	33.1	36.5	31.8	33.1	0.0	0.0	43.0	0.0	36.5	22.7	22.9	21.5	113
42109	30.2	55.2	54.3	57.1	46.0	47.9	48.6	51.6	47.9	72.0	0.0	0.0	0.0	72.0	39.3	46.4	0.0	23
6216	8.7	5.3	5.0	0.0	0.0	4.6	11.2	0.0	0.0	0.0	0.0	0.0	0.0	11.2	2.7	3.2	0.0	28
11192	4.2	5.9	5.1	5.9	6.8	4.2	5.1	6.8	8.5	3.7	0.0	0.0	0.0	8.5	4.3	5.1	0.0	17
39218	2.0	4.2	6.8	4.2	4.2	6.8	7.6	4.2	4.2	5.1	0.0	2.0	0.0	7.6	4.0	4.5	1.0	17
52618	8.5	117.5	0.0	110.6	97.2	65.2	114.1	68.4	101.3	76.2	56.8	62.3	63.6	117.5	72.4	74.2	63.0	168

Republican River Active Surface Water Rights Senior to the Minimum Desirable Streamflow (MDS)
ac-ft used

Pdiv_ID	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Max 1994 - 2004	Averages			Authorized Quantity
														Period	1994 - 2004	2005 - 2006		
39763	0.0	27.5	4.4	0.0	55.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.7	6.7	8.0	0.0	33
36983														0.0				0
30097	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.3	0.3	0.0	33
39218	2.0	4.2	6.8	4.2	4.2	6.8	7.6	4.2	4.2	5.1	0.0	2.0	0.0	7.6	4.0	4.5	1.0	17
11192	4.2	5.9	5.1	5.9	6.8	4.2	5.1	6.8	8.5	3.7	0.0	0.0	0.0	8.5	4.3	5.1	0.0	17
20554	73.7	70.0	73.7	117.8	154.7	151.0	165.7	155.5	165.7	85.0	102.0	74.0	34.0	165.7	109.5	119.6	54.0	120
493	60.6	70.9	76.9	83.9	88.3	85.3	94.6	88.5	111.8	105.1	57.1	54.8	90.4	111.8	82.2	83.9	72.6	140
47600	38.0	43.7	30.4	0.0	0.0	22.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.7	10.3	12.2	0.0	33
54870	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73
37038	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150
Total	1,970	3,228	2,693	2,857	2,890	3,485	3,947	3,487	4,189	3,136	1,983	1,809	1,548	6,241	2,863		1,679	8,237
Average	21	34	28	30	30	37	42	37	45	33	21	19	16	59	30	32	18	78
Additional Divisions														4,431	4,693			

Note: Pdiv_ID list consists of active irrigation surface water rights located between Spring Creek and Concordia, KS, including mainstem and tributaries, and senior to MDS.
No water use data was available for Pdivs that are blank.
Additional Divisions = Total Max (1994 - 2004) - Total Actual for the specific year

Attachments

Attachment 1

Nebraska's Violation of Water-Short Year Administration Requirement 2005 and 2006

Table 5C Nebraska's Compliance During Water-Short Year Administration (from App. C of the FSS p. C65)*								
Year	Allocations			Computed Beneficial Consumptive Use (CBCU)			Credits from Imported Water	Difference Between Allocation and Consumptive Use Minus Imported Water Supply above Guide Rock
Column	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
	State Wide Allocation	Allocation below Guide Rock	State Wide Allocation above Guide Rock	State Wide CBCU	CBCU Below Guide Rock	State Wide CBCU Above Guide Rock	Credits above Guide Rock	Col 3 – (Col 6 – Col 7)
2005	199,450	4,586	194,864	253,740	4,052	249,688	11,965	(42,860)
2006	187,060	2,290	184,770	236,150	3,064	233,086	12,214	(36,100)
Average	193,260	3,440	189,820	244,950	3,560	241,390	12,090	(39,480)

*All average and total values are rounded to the nearest 10.

For 2005, two accountings were approved by the RRCA. The difference was caused by dispute over the inclusion or exclusion of evaporation from non-federal reservoirs in Nebraska below Harlan County Reservoir. The values displayed are from the accounting includes all non-federal reservoir evaporation in Nebraska, as proposed by Kansas.

For 2006, no accounting was approved by the RRCA. Only input data for the accounting was approved. The values displayed are from an accounting consistent with Kansas position on accounting inclusive of (1) all non-federal reservoir evaporation in Nebraska and (2) a Harlan County Reservoir evaporation assignment method that assigns evaporation to both Kansas and Nebraska when only one State takes water from Harlan County Storage.

The totals for 2005 and 2006 from table 5C are below:

Year	Allocations			Computed Beneficial Consumptive Use (CBCU)			Credits from Imported Water	Difference Between Allocation and Consumptive Use Minus Imported Water Supply above Guide Rock
Column	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
	State Wide Allocation	Allocation below Guide Rock	State Wide Allocation above Guide Rock	State Wide CBCU	CBCU Below Guide Rock	State Wide CBCU Above Guide Rock	Credits above Guide Rock	Col 3 – (Col 6 – Col 7)
Totals	386,510	6,880	379,630	489,890	7,120	482,770	24,180	(78,960)

Note: Attachment 1 of the December 19, 2007 letter to Ann Bleed from David Barfield with revised 2006 values resulting from corrections made in the RRCA accounting spreadsheet.

Attachment 2

Nebraska's Five-Year Running Average Allocation and Computed Beneficial Consumptive Use for Determining Compact Compliance 2003 through 2006

Table 3C: Nebraska's Five-Year Average Allocation and CBCU (from App. C of the Fss p. 62)*				
	Col. 1	Col. 2	Col. 3	Col. 4
Year	Allocation	Computed Beneficial Consumptive Use	Credits from Imported Water Supply Credit	Difference between Allocation and Computed Beneficial Consumptive Use minus Imported Water Supply
2003	227,580	262,780	9,782	(25,420)
2004	205,630	252,650	10,386	(36,630)
2005	199,450	253,740	11,965	(42,330)
2006	187,060	236,150	12,214	(36,880)
2007				
Average	204,930	251,330	11,090	(35,320)

*All average and total values are rounded to the nearest 10.

The values for 2003 and 2004 were approved by the Republican River Compact Administration.

For 2005, two accountings were approved by the RRCA. The difference was caused by dispute over the inclusion or exclusion of evaporation from non-federal reservoirs in Nebraska below Harlan County Reservoir. The values displayed are from the accounting includes all non-federal reservoir evaporation in Nebraska, as proposed by Kansas.

For 2006, no accounting was approved by the RRCA. Only input data for the accounting was approved. The values displayed are from an accounting consistent with Kansas position on accounting inclusive of (1) all non-federal reservoir evaporation in Nebraska and (2) a Harlan County Reservoir evaporation assignment method that assigns evaporation to both Kansas and Nebraska when only one State takes water from Harlan County Storage.

The totals of table 3C are below:

Year	Allocation	Computed Beneficial Consumptive Use	Credits from Imported Water Supply Credit	Difference between Allocation and Computed Beneficial Consumptive Use minus Imported Water Supply
Totals for 2003 to 2006	819,720	1,005,320	44,350	(141,260)

Note: Attachment 2 of the December 19, 2007 letter to Ann Bleed from David Barfield with revised 2006 values resulting from corrections made in the RRCA accounting spreadsheet.